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RECENT USSR WORK ON AIR PURIFICATION

[Numbers in parentheses refer to appended sources.]

The problem of air purification is stressed in the USSR. Soviet institutes of hygiene have carried out extensive and manifold investigations on the subject. The degree and nature of contamination of the air of populated localities, the distribution of dust and gases emanating from industrial enterprises as a function of the distance from these enterprises, and the possible effects of this dust and gas on the health of the population have been investigated. Methods of determining individual contaminants and their concentration in the air have been devised.

The results of investigations that had been carried out made it possible to classify industrial enterprises from the sanitary standpoint and protective zones which must be established between these enterprises and residential sections. On the same basis, sanitary standards have been established relative to the elimination of harmful substances from industrial wastes released into the air.

Following a special instruction by the government, the maximum permissible concentrations of harmful substances in the air were determined in 1949. The standards based on this work were confirmed by the Ministry of Health USSR. The sanitary institutions use them as one of the most important guides in practical work on the purification of the air of populated localities.

A characteristic trait of Soviet research carried out after World War II in this field of hygiene is the transition to many-sided investigations of the effects of environment on the human organism on the basis of I. P. Pavlov's physiological teaching. The results of research of this type have made available to public health organs new scientific data for the extensive realization of prophylactic measures in accordance with directives given by the 19th Congress of the CPSU.

Legal regulations exist in the USSR which prohibit the designing and activation of enterprises, plant departments, or industrial aggregates which release into the air harmful gases, vapors, or dust without appropriate treatment in installations that purify these effluents. The economic plans allocate many millions every year for the design and construction of such installations to be operated at enterprises which already exist or are under construction.

More than 400 installations for gas purification are in operation in Moscow alone. All Moscow electric power plants and central thermal electric power plants are provided with equipment for the collection of ashes. At one of these power plants, the first experimental installation in the world for the purification of smoke from sulfur dioxide was put into operation. This sulfur dioxide, being a valuable chemical raw material, can be used by the industry. According to observations carried out by hygienists, the transparency of the air in Moscow has been considerably increased by the measures taken.

According to a decision by the Executive Committee of the Moscow Soviet, 20 control stations will be organized to carry out constant observations with a view of controlling the purity of the air of the capital.

The purity of the air in a number of populated locations is not yet up to established standards. Many ministries, such as those of electric power stations, of ferrous metallurgy, of nonferrous metallurgy, of the chemical

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industry, and of construction materials pay insufficient attention to the problems involved. These ministries forget that the control of industrial wastes not only establishes favorable conditions as far as the health of the population is concerned but also creates huge additional economic resources.

Equipping electric power stations, which burn coal mined in the Moscow region, with installations for sulfur recovery will make it possible to recover about 500,000 tons of sulfur dioxide per year.

The ministries do not control strictly the execution of plans concerning the construction of installations for gas purification. As a result, the funds which have been assigned are not used soon enough in many cases. For instance, the construction of electric filters at the Chelyabinsk Zinc Plant has been delayed for a long time. A flagrant violation of regulations has taken place at Nizhniy Tagil. Effective filters have been installed for the purification from ash of the smoke gases released by the Central Thermal Electric Power Plant operated at the Novo-Tagil'sk Metallurgical Plant. The project also called for removal of the ash from the filters by washing it out with water. Instead, the directors of the plant and of the thermal electric power station installed special equipment by means of which the ash that had been filtered out (several hundred tons per day) is blown back into the smokestack and released at night into the air of the city.

Notwithstanding the energetic measures taken by the sanitary authorities, the situation at Nizhniy Tagil has not changed as yet. A complaint filed with the oblast prosecutor's office has been of no avail, because this office was of the opinion that no violation of law had taken place.

The rate of construction of gas purification installations at the Nizhniy Tagil Metallurgical Plant, the Coke-Chemical Plant [at Nizhniy Tagil] and the Ural Railroad Car Plant have been slowed down in an inexcusable manner. Because of the absence of technical control, many of the newly erected gas purification installations are not operated properly: they often stop, do not run during the night, etc. For instance, at the Dor Chemical Plant (Dorkhimzavod) the available gas purification installations are not being used properly. The construction of new installations for the prevention of contamination of the air is not being carried out satisfactorily. It is evident that these and similar occurrences are a result of the relaxation of vigilance by organs of the sanitary inspection. The medical-sanitary detachments of the plants and the institutional sanitary services no longer participate in this important work.

The heads of the public health organs have also withdrawn from this work on their own initiative. Thus, the heads of the Saratov Oblast and Saratov municipal public health departments Mikhaylov and Korolev regard the activities aimed at the purification of the city air as not very urgent. These erroneous views find support at the medical higher educational institution and the oblast sanitary-hygienic institute. Investigations in the field of air hygiene and of the prevention of air contamination are not supported by these institutions.

Air hygiene is one of the most important fields of prophylaxis for which the heads of the organs of public health and of industrial enterprises are responsible. Proper records must be kept on the operation of every installation for gas purification. The administration of enterprises has the duty of assigning competent and well-instructed personnel to the operation of these installations.

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It is necessary to engage the medical-sanitary detachments, the institutional sanitary services, and the communities as a whole in activities aiming at the prevention of contamination of the air of populated localities with gases, vapors, and dusts released by industrial enterprises. The task consists in enforcing rigid compliance with requirements in regard to the proper operation of installations for gas purification. Socialist competition must be organized between brigades which operate installations of this type. The "houses of sanitary education" and sanitary-epidemiological stations must carry out educational work and conduct propaganda on the subject of air purification.

The sanitary organs must become more exacting and apply fully the rights conferred on them. The operation of plant departments and aggregates which are not equipped with installations for purification of the waste released by them should not be permitted.

The exhaust gases of automotive vehicles play a considerable role in the contamination of the air. By oxidizing the carbon monoxide of exhaust gases into carbon dioxide these gases can be rendered harmless. The solution of the problem involved in this oxidation was entrusted as early as 1949 to the Scientific Research Institute of Industrial and Sanitary Gas Purification of the Ministry of Chemical Industry and to the Scientific Research Automotive Institute of the Ministry of the Automotive and Tractor Industry. Unfortunately, the problem has not been solved as yet.

The organs of the State Automobile Inspection bear a share of the blame. They permit the operation of automotive vehicles in which the motors do not work properly. It is known that when the motor works properly, the content of carbon monoxide in the exhaust gases is sharply reduced.

It is the duty of the sanitary organs to carry out constantly laboratory test to control contamination of the air. It is also absolutely necessary to carry out systematic observation to establish whether the health of the population, and particularly the health of the children, is endangered, so that the effectiveness of the measures to prevent contamination of air can be checked. The Ministry of Health USSR should organize the production of equipment for the detection of dust and gases and for the recording of meteorological conditions in connection with this. One of the most urgent problems is the development of devices for the automatic recording of the concentration of contaminating substances in the air. Laboratories of air hygiene must be organized at the sanitary-epidemiological stations in industrial areas.

Of the greatest importance is the development of technological processes which would eliminate or sharply curtail the release of harmful wastes into the atmosphere. Some of these processes are smokeless combustion of fuel at electric power stations; the use of furnaces from which the slag is removed in the liquid state, so that the main quantity of the ash is retained in the furnace rather than blown out in the form of dust; and separation of pyrite, a measure which can cut by half the release of sulfur dioxide into the atmosphere.

Simultaneously with the construction of central electric power stations which use solid fuel having a high ash content, enterprises must be constructed for the utilization of the ash which is formed at these stations.

More attention must be paid to the shortcomings in the training of personnel for work in this field. None of the higher technical educational institutions has a chair which prepares specialists in gas purification and dust collection techniques. During recent years, not a single dissertation on this subject has been defended. The All-Union Society on the Dissemination of Political and Scientific Knowledge also neglects this problem; not a single lecture held under its auspices dealt with this subject.

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The elimination of these shortcomings will contribute to further success in activities aiming at the purification of air. Under the conditions of a planned socialist economy, Soviet science and technology will successfully solve this problem in the shortest possible time. (1)

From 22 to 24 March 1955, a meeting took place which dealt with the present status and prospects of the removal of dust from industrial waste gases and vapors released into the air by industrial establishments and ventilation installations. This meeting had been organized by the Commission on the Coordination of Scientific and Technical Work in the Field of Purification of Industrial Waste Gases and Vapors Released Into the Atmosphere. This commission is subordinate both to the Ministry of Chemical Industry and to the Ministry of Health USSR.

The meeting was distinguished by the extensive participation of workers at scientific research institutes dealing with sanitary-technical and hygienic methods, representatives of the State Sanitary Inspection, engineering and technical workers who design, assemble, and operate installations for the elimination of dust, and representatives of the industry.

At the meeting, more than 16 reports were presented and discussed. They dealt with the hygienic effectiveness of measures taken against contamination of the atmosphere of cities and of industrial centers with dust (L. F. Glebova, Candidate of Medical Sciences); experience in the operation of wet absorbers of the VTI [All-Union Thermal Engineering Institute imeni Felix Dzerzhinskiy] type; and the elimination of dust from gases being exhausted into the atmosphere by means of electric filters, comprising removal of fly ash from the smoke gases of furnaces and the retention of soot and cement dust (Engr M. A. Al'perovich, State Planning Institute for Gas Purification).

They also dealt with purification of smoke gases in cyclone batteries and cyclones of the NIIOGaz [Scientific Research Institute of Industrial and Sanitary Gas Purification] design (Engr M. M. Zaytsev, NIIOGaz); the application of sleeve filters and electric filters for the purification of gases released by the enterprises of the nonferrous metallurgy (I. L. Peysakhov, Candidate of Technical Sciences); the two-stage adsorption of dust in the cement industry (Engineer Dzhansis); the turbulent Venturi tube sprayer which prepares a suspension of solid particles in a gas or in air for subsequent removal of the solids in the form of dust (Engr F. I. Murashkovich, NIIOGaz); tests carried out by means of a Venturi tube equipped with a scrubber and attachment (V. V. Kucheruk, Candidate of Technical Sciences, and Engr N. I. Mosolov, Moscow Institute of Labor Safety [MIOT]); and the operation of an apparatus working on the principle of impact washing (A. A. Savin, Senior Scientific Associate, Leningrad Institute of Labor Safety [LIOT]).

Also included were reports on industrial applications of equipment working on the principle of foam formation (Prof M. Ye. Pozin and Docent I. P. Mukhlenov); centrifugal rotary dust absorbers of the TzRP [centrifugal rotary device] type (I. S. Rozenkrants, Candidate of Technical Sciences, and F. A. Prechistenskiy); a method for increasing the size of dispersed particles in an air stream moving in narrow channels by condensing on the particles water vapor generated in heated baths (S. I. Dukiin, the Kriivoreg Division of the Scientific Research Ore Mining Institute, Academy of Sciences USSR); the application of ultrasound for dust precipitation (Docent P. N. Kubanskiy); the present status of the removal of fly ash from smoke gases at electrical power plants (V. G. Zeligman); and the purification from dust of gases released into the air at nonferrous metal enterprises (I. L. Peysakhov, Candidate of Technical Sciences).

After discussing the reports which have been mentioned, the coordination commission passed the following resolution of the basis of proposals which had been made:

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The rapid rate of development of the industry and the expansion and modification of already existing plants combined with extensive construction of new industrial plants have imposed on the industry and the public health organs the important task of carrying out stronger measures directed against the contamination of the atmosphere with industrial wastes.

In connection with this, major measures are being taken at cities and industrial centers to combat the contamination of the air. Rigid regulations have been passed which must be observed by new industrial enterprises prior to starting operations. These enterprises must be provided with equipment for gas purification and may start operations only under the condition that this equipment will be ready for operation at the time when production is started.

The economic plan provides every year for the assignment of considerable funds to be used in the construction of gas purification and dust absorption installations at active enterprises.

Since 1948, extensive work has been carried out on the purification of the air at cities and industrial centers. As of the first of January 1958, 2,000 installations for the purification of gases, elimination of dust, and recovery of vapors and gases have been in operation at the industrial enterprises of the USSR. Installations for the recovery and elimination of the most diverse substances have been designed and introduced into industrial use.

Notwithstanding the achievements which have been mentioned, the majority of enterprises still continue to contaminate the atmosphere with wastes in the form of dust.

Problems which have a bearing on the purification of industrial wastes by removing dust at metallurgical plants, plants which manufacture building materials, and a number of chemical enterprises remain in need of an urgent solution.

There are still cases when new industrial enterprises start operations without having completed the installation of their equipment for the elimination of dust.

At present there are still no clear specifications issued by specialized organizations such as the Gas Purification Trust, the State Planning Institute of the Cement Industry, or the State Planning Institute of Nonferrous Metallurgical Enterprises in regard to the selection of efficient equipment for the recovery of some types of dust, e. g., that derived from the waste gases of rotary cement kilns or from gases emitted by open hearth furnaces and cupola furnaces. This also applies to the elimination of dust from carbon black which is formed when combustion of fuels is carried out in burners.

The dust-recovery equipment which has already been introduced into industrial use has a number of major shortcomings. The designing, production, delivery, and introduction into operation sometimes proceed with great delays. The time limits imposed by contracts are not always observed.

Increased attention must be paid to systematic technical control of the efficiency of the operation of dust recovery installations and to the continuous production of automatic dust recorders which are needed for the realization of this control.

The ministries of the chemical industry, of nonferrous metallurgy, of ferrous metallurgy, of the industry of construction materials, of electric power stations, and others, do not pay adequate attention to the operation of dust recovery equipment at the enterprises run by them. The specialized branch scientific research institutes do not carry out adequate studies pertaining to the operation of dust-recovery equipment which is already in use (electric filters, sleeve filters,

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cyclones, etc.). They hardly do any research on processes which take place in electric filters or conduct any studies on the properties of dust, such as the mutual adhesion of particles, degree of dispersion, electrical resistance, etc.

To overcome any lag in the execution of tasks given the industry as far as the purification of waste gases from dust is concerned, the coordination commission considers it necessary to charge the presidium with the following undertakings:

1. Creation of working commissions on methods of dust collection. These commissions should within a period of 3 months draw up proposals on the further directions to be taken by scientific research work and bring these recommendations to the attention of all leading scientific research institutes which are active in the field of dust collection and gas absorption.
2. Creation of working commissions according to individual branches of the industry (nonferrous and ferrous metallurgy, the building industry, the power industry, the chemical industry of construction materials, etc.), with the obligatory participation of representatives from the State Sanitary Inspection of the Ministry of Health USSR. These commissions ought to draw up within 3 months recommendations on the application of available dust collectors depending on local conditions and bring these recommendations to the attention of the technical administrations of ministries which are interested in the subject. The results of the work done by these commissions should be published in the periodical press in order to give the widest possible distribution to the recommendations.
3. The technical administrations of the ministries in question should be requested to include in the 1956 plans of the institutes under their administration (i. e., Scientific Research Institute of Industrial and Sanitary Gas Purification [NIIOGaz], State Scientific Research and Production Institute of Nonferrous Metals [Gintsvetmetal], All-Union Heat Engineering Institute imeni Felix Dzerzhinskiy [VTI], Leningrad Institute of Labor Safety [LIOT], Moscow Institute of Labor Safety, [MIOT], the sanitary hygienic institutes, etc.), following subjects:
  - a. Summarization of experience acquired in the operation of individual dust collector installations
  - b. Drawing up of clear rules for the testing of dust collectors on experimental racks and under industrial conditions
  - c. Collection of data on the characteristics of different dusts (the degree of dispersion, the chemical composition, the adhesive quality, etc.), so that these data may be arranged systematically for the purpose of compiling a handbook on the properties of dusts
  - d. Setting up of standards for the highest permissible quantity of dust which may be ejected into the atmosphere depending on the characteristics of the dust, the height at which it is ejected, and the capacity of the source of dust generation
  - e. Directing of a request to the Ministry of Chemical Industry USSR, that opportunities be made available to the Scientific Research Institute of Industrial and Sanitary Gas Purification for expanding work of this institute on new methods of dust collection and gas absorption and improving the methods which are already in use.
  - f. Investigation of the possibility of organizing at the Ministry of Higher Education specialized instruction for workers in the field of gas purification, with the view that specially trained persons be subsequently assigned to work in this field at industrial installations and scientific research institutes.

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6. The calling of special meetings on the following problems:

- a. Elimination of waste products and their utilization after removal from dust collector installations operating at high capacity industrial enterprises and electric power stations
- b. The collection of ash and removal of ash at small and medium-sized boiler rooms

As far as the application of new dust collector equipment and of methods for dust collecting proposed at the meeting are concerned, the coordination commission has reached the following conclusions:

1. The wet rod dust collector with scrubber of the VTI design can be used as an ash collector. Its design should be appropriately modified as soon as possible.
2. The foam dust collector should be used for the elimination of dust at installations of medium capacity. It can be applied when the substances that are handled have no corrosive effect and water which splashes over does not interfere with the operation of the collector. The use of this equipment is not recommended for the collection of dust which has a high degree of dispersion. The commission considers it necessary to carry out tests with this type of equipment under operation conditions. Specifically, one should expedite the preparations for testing this equipment at the Saratov Main Electric Station.
3. The turbulent washer (a sprayer tube provided with a cyclone) can be used for collecting highly dispersed dusts. This equipment is recommended for use in cases when its application is not restricted by the magnitude of the hydraulic resistance which is encountered.
4. The centrifugal rotary dust collector Tsrp should be tested under plant conditions with the use of dry dust and at a rate of treatment corresponding to 5,000—10,000 cubic meters of gas per hour.
5. The method of the Krivoy Rog Scientific Research Ore Mining Institute which involves increasing the size of particles by condensation of steam may be used for the purification of small volumes of gas when the concentration of dust is low.
6. The dust collector of the LIOT type based on the principle of impact washing may be recommended for the purification of air being ventilated at installations of low capacity treating up to 2,000 cubic meters of air per hour. Its action should be checked under operational conditions at installations of higher capacity.
7. The ultrasound method of eliminating dust from gas has not yet been developed sufficiently. The commission regards it as advisable to continue scientific research on the collection of dust by applying ultrasound for this purpose.

SOURCES

1. M. Gol'dberg, For Purer Air, Meditsinskiy Rabotnik, Vol 13, No 14, Moscow, 3 February 1955, p3
2. V. V. Kucheruk, A Conference on Problems of the Removal of Dust From Gases and Vapors Exhausted Into the Atmosphere By Industrial Establishments and Ventilator Installations, Vodosnabzheniye i Sanitarnaya Tekhnika, No 4 Moscow, July 1955, pp 38-40

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